

## EXPONENT RULES &amp; PRACTICE

1. **PRODUCT RULE:** To multiply when two bases are the same, write the base and ADD the exponents.

$$x^m \cdot x^n = x^{m+n}$$

Examples:

A.  $x^3 \cdot x^8 = x^{11}$

B.  $2^4 \cdot 2^2 = 2^6$

C.  $(x^2y)(x^3y^4) = x^5y^5$

2. **QUOTIENT RULE:** To divide when two bases are the same, write the base and SUBTRACT the exponents.

$$\frac{x^m}{x^n} = x^{m-n}$$

Examples:

A.  $\frac{x^5}{x^2} = x^3$

B.  $\frac{3^5}{3^3} = 3^2$

C.  $\frac{x^2y^5}{xy^3} = xy^2$

3. **ZERO EXPONENT RULE:** Any base (except 0) raised to the zero power is equal to one.

$$x^0 = 1$$

Examples:

A.  $y^0 = 1$

B.  $6^0 = 1$

C.  $(7a^3b^{-1})^0 = 1$

4. **POWER RULE:** To raise a power to another power, write the base and MULTIPLY the exponents.

$$(x^m)^n = x^{m \cdot n}$$

Examples:

A.  $(x^3)^2 = x^6$

B.  $(3^2)^4 = 3^8$

C.  $(z^5)^2 = z^{10}$

5. **EXPANDED POWER RULE:**

$$(xy)^m = x^m y^m \quad \left(\frac{x}{y}\right)^m = \frac{x^m}{y^m}$$

Examples:

A.  $(2a)^3 = 2^3 a^3 = 8a^3$

C.  $\left(\frac{x^2}{y}\right)^4 = \frac{(x^2)^4}{y^4} = \frac{x^8}{y^4}$

B.  $(6x^3)^2 = 6^2 (x^3)^2 = 36x^6$

D.  $\left(\frac{2x}{3y^2}\right)^3 = \frac{(2x)^3}{(3y^2)^3} = \frac{2^3 x^3}{3^3 (y^2)^3} = \frac{8x^3}{27y^6}$

6. **NEGATIVE EXPONENTS:** If a factor in the numerator or denominator is moved across the fraction bar, the sign of the exponent is changed.

$$x^{-m} = \frac{1}{x^m} \quad \frac{1}{x^{-m}} = x^m \quad \left(\frac{x}{y}\right)^{-n} = \left(\frac{y}{x}\right)^n$$

Examples:

A.  $x^{-3} = \frac{1}{x^3}$

B.  $4^{-2} = \frac{1}{4^2} = \frac{1}{16}$

C.  $-4x^5y^{-2} = \frac{-4x^5}{y^2}$

D.  $\left(\frac{x^2}{y}\right)^{-3} = \left(\frac{y}{x^2}\right)^3 = \frac{y^3}{x^6}$

E.  $(3x^{-2}y)(-2xy^{-3}) = -6x^{-1}y^{-2} = \frac{-6}{xy^2}$

F.  $\frac{a^{-2}b^3}{c^{-4}d^{-1}} = \frac{b^3c^4d}{a^2}$

G.  $(-2x^2y^{-4})^{-2} = \left(\frac{-2x^2}{y^4}\right)^{-2} = \left(\frac{y^4}{-2x^2}\right)^2 = \frac{y^8}{4x^4}$

**CAUTION:**  $-x \neq \frac{1}{x}$  For example:  $-3 \neq \frac{1}{3}$

**REMEMBER:** An exponent applies to only the factor it is directly next to *unless* parentheses enclose other factors.

Examples:

A.  $(-3)^2 = (-3)(-3) = 9$

B.  $-3^2 = -9$

## EXPONENTS PRACTICE

Simplify:

1.  $3 \cdot 4^3$
2.  $4x^3 \cdot 2x^3$
3.  $x^5 \cdot x^3$
4.  $2x^3 \cdot 2x^2$
5.  $\frac{6^5}{6^3}$
6.  $\frac{x^4}{x^7}$
7.  $8^0$
8.  $-(9x)^0$
9.  $(y^4)^3$
10.  $(x^2y)^4$
11.  $\frac{6x^7}{2x^4}$
12.  $\frac{8x^5}{4x^2}$
13.  $(2cd^4)^2(cd)^5$
14.  $(2fg^4)^4(fg)^6$

15.  $\frac{x^5y^6}{xy^2}$
16.  $\frac{x^2y^5}{xy^4}$
17.  $\left(\frac{4x^5y}{16xy^4}\right)^3$
18.  $\left(\frac{5x^3y}{20xy^5}\right)^4$
19.  $y^{-7}$
20.  $7^{-2}$
21.  $\frac{1}{x^{-5}}$
22.  $\frac{1}{2^{-4}}$
23.  $x^5 \cdot x^{-1}$
24.  $x^{-6}$
25.  $x^9 \cdot x^{-7}$
26.  $(j^{-13})(j^4)(j^6)$

27.  $\frac{x^{-1}}{x^{-8}}$
28.  $\frac{52x^6}{13x^{-7}}$
29.  $f^{-3}(f^2)(f^{-3})$
30.  $\frac{x^{-4}}{x^{-9}}$
31.  $\frac{24x^6}{12x^{-8}}$
32.  $\frac{3x^2y^{-3}}{12x^6y^3}$
33.  $(2x^3y^{-3})^{-2}$
34.  $\frac{2x^4y^{-4}}{8x^7y^3}$
35.  $(4x^4y^{-4})^3$
36.  $5x^2y(2x^4y^{-3})$
37.  $\left(\frac{-7a^2b^3c^0}{3a^3b^4c^3}\right)^{-4}$
38.  $\left(\frac{-2a^3b^2c^0}{3a^2b^3c^7}\right)^{-2}$

## EXPONENTS PRACTICE ANSWERS

1. 192
2.  $8x^6$
3.  $x^8$
4.  $4x^5$
5. 36
6.  $\frac{1}{x^3}$
7. 1
8. -1
9.  $y^{12}$
10.  $x^8y^4$
11.  $3x^3$
12.  $2x^3$
13.  $4c^7d^{13}$
14.  $16f^{10}g^{22}$
15.  $x^4y^4$

16.  $xy$
17.  $\frac{x^{12}}{64y^9}$
18.  $\frac{x^8}{256y^{16}}$
19.  $\frac{1}{y^7}$
20.  $\frac{1}{49}$
21.  $x^5$
22. 16
23.  $x^4$
24.  $\frac{1}{x^6}$
25.  $x^2$
26.  $\frac{1}{j^3}$
27.  $x^7$
28.  $4x^{13}$

29.  $\frac{1}{f^4}$
30.  $x^5$
31.  $2x^{14}$
32.  $\frac{1}{4x^4y^6}$
33.  $\frac{y^6}{4x^6}$
34.  $\frac{1}{4x^3y^7}$
35.  $\frac{64x^{12}}{y^{12}}$
36.  $\frac{10x^6}{y^2}$
37.  $\frac{81a^4b^4c^{12}}{2401}$
38.  $\frac{9b^2c^{14}}{4a^2}$

$$\begin{array}{l} 4^2 = 16 \\ 4^1 = 4 \\ 4^0 = 1 \end{array} \left. \begin{array}{l} \\ \\ \end{array} \right) \div 4$$
$$4^{-1} = \frac{1}{4}$$
$$4^{-2} = \frac{1}{16}$$